The Role of the Water Power Function of the BLM

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Since the late 1800's, the Federal Government has been involved with identifying, evaluating and protecting reservoir resources until such time as the resource is needed. Since around the turn of the century, the government has been regulating their development for the national interest and the benefit of all people. This does not commit the government to the development of the resource but is a form of long-range planning. The primary governmental agency with the responsibility for the initial identification and evaluation of the potential sites is the Bureau of Land Management (BLM). Protection of the sites is accomplished by withdrawing the affected federal land from operation of certain of the public land laws. The regulation of their development is controlled by the Congress, statutes or the Federal Energy Regulatory Commission.

BACKGROUND

By the mid-1800's the developing and expanding United States had acquired territories and expanded to the borders that it now occupies. In the west, new resources had been discovered and migrations to the mining and agriculture centers had started. The government began wrestling with questions of its responsibilities to monitor and perhaps regulate the development of certain resources in the national interest. Concurrently, various governmental agencies, universities and entrepreneurs were exploring the west for resources, establishing surveys and scientific expeditions and accumulating pertinent knowledge although in somewhat of a chaotic manner.

When the Civil War broke out many of the initial mineral resource "finds" were utilized to fund the war effort, but the war curtailed the more scientific explorations. However, a new and larger migration of settlers ensued after the war. This new wave of settlers brought into focus again the question of government's responsibilities for protecting limited resources. The Congress asked the National Academy of Sciences to investigate surveying the west and make a recommendation back to Congress. (5/)

On March 3, 1879, the Congress passed a law which established the United States Geological Survey (USGS) in accordance with the recommendation of

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the National Academy of Sciences. The purpose of the USGS was to conduct an orderly scientific survey of the nation's resources and classify the land as to its resource value. On the following dates Congress passed legislation authorizing the classification of land as to their waterpower or reservoir site values: October 21, 1888; June 20, 1910; twice on June 25, 1910; January 27, 1912; June 9, 1916; and February 26, 1919. The names are: Waterpower Classifications, Reservoir Sites, Reservoir Site Reserves, Power Site Reserves, Indian Power Site Reserves, and Waterpower Designations. The actions taken were named from the legislative nomenclature used in the act that authorized the classification. The group of these actions were often called "classifications."

Classification

Various levels of investigation and evaluation of the potential sites were conducted before classification. The initial classifications called "reservoir sites" that were made between 1888 and about 1896 required new maps and hydrology studies for each site. The maps were good but the hydrology information was scarce. Those classifications called "reserves" made after the acts in 1910 were usually sites under investigation by other entities, and some studies by the USGS. Those classifications called "designations" in the latter 1910's were made after an assessment of the power values of the streams. After the 1920's, the classifications called "classifications" usually were based on published river surveys and published "Water Supply Papers." The surveys and publications were a result of independent studies by the USGS and are still valid in most cases. The publication of this information is for planning or resource value purposes.

It is important at this time to define what is actually being accomplished by the classification of federal land for the purposes of waterpower or reservoir sites. A reconnaissance level evaluation is made of the potential sites available, and those sites that warrant future consideration are classified. The classification of the land requires a notation on the land records of the government. This notation serves as notice to the land management agency that they are required to consider the waterpower or reservoir site values before taking discretionary actions (the manager has legal constraints on his range of options). Thus, the classification of the land for waterpower or reservoir sites is a form of long-range planning. Conceivably, the best sites will remain in federal ownership and be available for development when needed.

It should be pointed out that the potential reservoir is not necessarily the highest and best use of the land, but is a significant use that needs to be considered. The classification is not a commitment on the part of the Federal Government to build or develop the reservoir, but in some ways it is protecting the resource so that it is available, if and

when needed. The classification may cover several alternative sites or a single recognized dam and reservoir configuration, conversely, several classifications may be found in one reservoir.

The above described classification process is the responsibility of the BLM. The Waterpower Program was transferred from the USGS to the BLM via Minerals Management Service in 1983. The Waterpower staff locations are in the California State Office, Sacramento, California; Colorado State Office, Denver, Colorado; and the Oregon State Office, Portland, Oregon, and the staff have regional responsibilities.

Regulation

Another agency that is closely integrated in this waterpower resource protection program is the Federal Energy Regulatory Commission (FERC) in the Department of Energy. They came into existence as the Federal Power Commission by the Act of June 10, 1920, now known as the Federal Power Act. The Commission was given the regulatory and licensing responsibilities of waterpower development, the exception being those projects authorized and funded by Congress. (Note: The responsibilities do not cover reservoir sites unless hydroelectric facilities are a a part of the project.) The Commission can authorize preference rights for studies, issue the license to construct the potential dam, regulate actual construction of waterpower projects and also collect fees for the occupancy of the federal land. Applications for permits and/or licenses produce an automatic withdrawal of the land from the public land laws to protect the permittee's or licensee's interest. (Note: the federally-funded projects have their own withdrawals to protect their interests.) These FERC withdrawals, the Corps of Engineers and Bureau of Reclamation withdrawals are for the protection of the interest of the development of the project which is distinct and different from classifications.

The Commission was also given the authority to determine if other uses could be allowed on classified or withdrawn land or if the other uses would be injurious to the waterpower values. It is in this capacity that the Commission has had much influence on the constraints placed on the land managers. They have found that there are non injurious uses which they have left to the discretion of the land managers. Secondly, they have found that there are uses that are non injurious if constructed facilities are removed and the land restored when the waterpower values need to be utilized. These uses are discretionary provided the land manager applies stipulations to the leases, permits, etc. The third category are those uses that may be injurious and they have determined such uses must be cleared by the Commission before the land manager may exercise his discretion.

Congress also has continued to maintain its regulation of these potential sites. In legislative actions they have restricted licensing of projects in Wild and Scenic Rivers and National Parks, etc. Other

instances they have made provisions for others to determine waterpower compatibility and development, such as the Secretary of Agriculture in some Wilderness areas. In some cases the legislature has revoked classifications at the time of establishing some other land action.

Withdrawal Review

It is imperative that the land manager recognize the waterpower resource; their possible conflicts and legal constraints; their long-range planning significance; and their control by the Secretary of the Interior and the FERC. The classifications were made by the USGS and withdrawals made by other entities on federal land, not by the land administration agency. It's also prudent that the BLM continually review these withdrawals to insure the validity of imposing these constraints on the managers. The Department of the Interior has recognized this and has had a waterpower withdrawal review program since 1955. Congress, on October 21, 1976, passed the Federal Land Policy and Management Act (90 Stat. 2743), part of which required land managers to recognize resources and review withdrawals on a periodic basis. The primary objective of the program in the BLM is to evaluate the sites that affect withdrawn land, so that any land unnecessarily withdrawn may be removed from withdrawal. Initially, all the withdrawals were screened to determine those land in withdrawal that are: (a) Locations where legislative and executive actions preclude waterpower and water storage development; (b) Locations where the water resource potential has been fully developed; (c) Locations where the runoff, including that from planned or feasible interbasin diversion, is inadequate for water resource development and where no significant, off-stream storage reservoirs have been identified; (d) Locations where waterpower potential would likely be developed by diversion-conduit methods;
(e) Locations withdrawn for transmission line purposes only; and
(f) Locations where current, reliable data clearly indicate that the geological and topographic characteristics are unfavorable for waterpower or water storage development. Those withdrawals found to be in the above catagories were recommended for revocation. Presently, the staff is evaluating those remaining reservoir sites affecting the withdrawals and making recommendations on the continuance or termination of the withdrawals. The decision is whether the characteristics of a particular site are valuable enough that the site should be considered by personnel evaluating sites for possible development. These recommendations are given to the land managers for appropriate comments before being raised to the Secretary of the Interior for final disposition.

SITE EVALUATIONS

When making an evaluation of a site for long-term purposes, several factors must continually be kept in mind. These factors usually involve future scenarios and not present conditions. Planners generally

question if the site is needed now or in the foreseeable future, or at least, is the site feasible now. Long-range planning needs to consider which variables are subject to change and which factors remain stable. Feasibility of building a site is generally the most fickle evaluation that can be made. Whether the site is needed, and the size of a site are two other factors subject to change. One quick example would be the effects of the 1973-74 oil embargo, which first of all immediately impacted the economics of building a dam and the benefits of producing power. Secondly, the embargo changes prospects of developing an oil shale industry on Colorado's western slope. The possibility of a new industry and new growth changed the concept of need for reservoirs. New reservoirs would be needed to supply water for the population change and to supply the water for oil shale development. As the need for potential reservoirs changed, so did the concept of the size of the reservoirs at specific sites.

To contrast these changeable factors, it should be pointed out that those areas that afford more favorable dam sites usually remain physically constant. The natural hydrologic conditions of the stream rarely change unless by alterations induced by mankind. However, both of these factors, the physical characteristics and the hydrology, change slightly as more knowledge is obtained about them such as topography (new maps), geology (further investigations) and hydrology (better gage records, etc.).

Methods

The Colorado State Office's Waterpower staff investigations are categorized into physical characteristics and hydrologic and socio-economic conditions. Their investigations are at the reconnaissance level consistent with long-range planning and the possible change of size and need for the potential site. The main factors influencing the decisions are the physical size of a potential reservoir and the effects that the potential reservoir may have on the stream at the sites' location. However, other factors are considered to insure a quality decision. There are 16 factors that are required to be addressed in the investigation, each acting like toggle switches to influence if the decision is positive or negative as far as the value of the site. The toggle switches are discussed below and have varying importance.

The reservoir must be one that involves federal land that is already in a waterpower classification, and after the site is investigated, the effects of any decision on the withdrawal is assessed and incorporated into the recommendation. Therefore, two of the toggle switches involve the relationship of the sites to the land withdrawals.

It is noted that the sequence of evaluation is chosen so that "fatal" toggle switches are looked at early before large amounts of time are expended. This consists of finding out what is already known about the site. Published information from previous investigations, including physical, geological and hydrologic descriptions is reviewed. Adequate

maps are located before starting the evaluation. All of these factors are considered with respect to current trends and current technology. If there is no indication that the potential site has had a field investigation, this step is taken first to assure mapping and known information is correct. Provided that there are no "fatal" toggle switches found and more information is needed for a decision, the staff starts new evaluations.

New evaluations start with hydrology and the toggle switches involve amounts of flowage and seasonal distribution. (Is there sufficient water and does the stream already have regulation?) Next, the effects of the potential reservoir on the stream is calculated, as an investigation of the relative sizing of the reservoir to the stream. These effects are then evaluated and quantified for resulting possible values. The values result from meeting needs in the basin, and the staff looks at recognized present and future needs. Before the staff makes recommendations, they are asked to review all of these "toggle" switches as an attempt to negate the influences of the latter investigations, which are present needs, economics, etc., and are the less stable factors.

Procedures

The information needed in order to make informed decisions at each "toggle" switch can be voluminous and the techniques and details are somewhat subjective. The staff is using automated systems whenever possible including personal computers (PC) to manage and control data, and to do calculations. The procedures used to generate the information for the decisions are briefly outlined below and are subject to change as more efficient programs, equipment, techniques, etc., are incorporated.

Manually, the withdrawals and known sites are plotted on USGS 7-1/2 minute topographic maps to match the potential sites and the withdrawals. At this time, any legal constraints affecting the sites are checked. Next, existing information sources are reviewed, including published reports, project applications to the FERC, withdrawal action files, and previous investigations of the Waterpower Program. Other agencies or companies may be contacted for further information.

The latest available and most detailed maps are utilized to note the physical characteristics of the site. From the topography maps, the "best" location for the site is chosen utilizing river profiles, noting obvious physical, legal or socio-economical constraints, dam cross-sections, as well as previous investigations. Once this initial location is set, the topographic quadrangle maps are digitized and the information entered into the Graphics Information System. Volumetric information on the dam and the capacity of the reservoir is calculated from the information. The digitizing step also allows the construction

of maps automatically at any scale, using various themes, and with or without color. Principal information utilized includes dam and reservoir configurations, withdrawals, public land survey lines, map coverage, and hydrologic unit lines.

Gaging record formation is obtained from the USGS via the "Nawdex-Watstore" information system. Normally, monthly flows are utilized, although daily flows may be obtained for flood investigations. Once captured on the PC, the flows are formatted for input to fortran programs written by the US Army Corps of Engineers Hydrologic Engineering Center (HEC) or for further manipulation on the PC. A rough "water balance" is made to insure flows are originating in the basin as expected. Beside the "balance," flows are evaluated over a specified period of time which requires some projection of gage records. The HEC program "Monthly Streamflow Simulation" (HEC-4) (1/) can be utilized for reconstituting missing records or records can be produced using a PC spreadsheet. The PC is used for the "balance" and has charting capability for visual comparison of gage records.

Once flows are accounted for in a basin, specific flows at a gage are selected for utilization for the site evaluation and adjusted to the selected period of record and the site location if needed, then they are routed through the potential reservoir. The HEC's "Simulation of Flood Control and Conservation Systems" (HEC-5) (2/) program can be utilized which, based on the flow record, will optimize conservation storage, and regulated outflows based on storage available. The Waterpower staff is utilizing the PC to generate a curve of amounts of storage required to produce firm outflows, and routing the flows through the reservoir to demonstrate a historical operation scheme. Not only are releases calculated but drawdown is also calculated. For a visual demonstration of the results, the natural hydrograph, the outflow hydrograph and the reservoir fluxuations are plotted on the same chart. An area-capacity curve may be generated to visually show the storage and area the reservoir will contain and occupy respectively.

Based on firm releases and average drawdown, a firm power figure is calculated to which is added the secondary power. It is calculated, using the water spilled over the total head. The HEC-5 program operated to optimize the reservoir for power releases can also be used to calculate power figures. A third way to calculate the potential power is utilizing the HEC's "Hydropower Analysis Using Streamflow Duration Procedures" (HYDUR) (3/) computer program. These constitute three different ways of calculating hydroelectric power potential, all of which are available to the engineer for use to estimate the power potential.

One other area that needs to be addressed is "what are the downstream effects of the reservoir?" Of course, this is a very difficult topic and perhaps beyond a reconnaissance evaluation. However, the unique

situations where the downstream benefits outweigh the actual specific site benefits need to be addressed. The HEC-5 program can handle multiple reservoirs and can be used for some comparison purposes. On the PC, outflows from one reservoir can be routed as inflow to the next reservoir, etc., and these tools are available if downstream effects and benefits are recognized as unusually significant.

Recognized needs in a basin are gained from the publication search described earlier, but perhaps at this time, it should be mentioned that the staff relies on the Water Resources Council's "Level B Reports" when available. Other sources are used also, such as publications, clippings, newspaper articles, etc. The assignment of values (that is, how can the potential reservoir meet those needs) is usually of a general nature. The value of a reservoir is its capability to redistribute the natural flows in a stream. The more regulation that is achieved, the more valuable the reservoir becomes to meet electric power, fish and wildlife, flood control, irrigation, municipal and industrial, pollution control, recreation or water quality demands. How well the reservoir will meet those demands is usually a function of priority setting and reservoir operation, rather than something that can be calculated.

However, models should be made and demonstrated, but this staff is not encouraged to try this at this time due to time constraints. One exception is flood routing where daily flows may be routed to demonstrate reservoir operation under flood conditions. Another value assessment that is made is the costing of producing hydroelectric power. Whether the power estimate is made by the HYDUR program or calculation on the PC, the US Army Corps of Engineers procedures are used for cost estimation (reconnaissance estimating as described in "Hydropower Cost Estimating Manual" of May 1972 (4/)). This is incorporated in the HYDUR program and a simple spreadsheet was developed on the PC. This task is done only to test the reasonableness the dam size to streamflow and as such, the estimate is left in 1979 dollars.

At this place in the sequence of procedures, it is time for the engineer to review all of the information known or generated about the site, make a decision if it warrants the classification, and prepare to advocate that decision. (The question is asked whether another engineer with the same information would come to the same conclusion.)

The last step after the decision is made and substantiated is to distribute the decision and information to impacted federal agencies. This involves informing the appropriate BLM State Office who will forward the information to the land manager, whether in the BLM or another agency. This manager should then incorporate the information into the planning system and take necessary action.

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